

**Executive Forum on Modeling & Simulation 2001**  
**31 May 2001**

# **Modeling & Simulation Executive Agent Panel**

**PRESENTER**

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**TECHNICAL DIRECTOR**

**OFFICE OF THE OCEANOGRAPHER OF THE NAVY**

**OCEAN EXECUTIVE AGENT**



# Three Primary Mission Areas

- **Safety of the Fleet and the Navy Shore Establishment**
- **Application of Meteorology and Oceanography (METOC) to optimizing performance of Navy Platforms, Weapon Systems and Sensors**
- **Application of Geospatial Information and Services (GI&S) and Precise Time and Astrometry (PTA) Data to Navigation, Communications**





# Community Size & Scope



< 0.4%  
Navy TOA

**Almost 3300 Total End Strength**

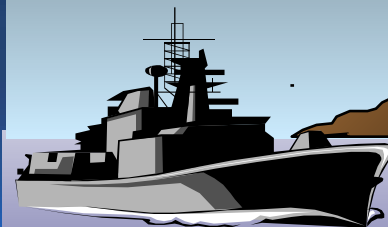
**8 Military Survey Ships**

**9 Major Activities**

**Almost \$400M Total Resources**

**\$36M R&D (6.4 & 6.5)**

Top of  
the  
Atmosphere



Sea  
Floor



# METOC Concepts

- **Overarching Theme:**
  - *Network-Centric METOC Operations*
- **Common METOC Picture**
  - 4-D Cube supporting COP/CTP
- **Collection of METOC Data in Denied Areas**
- **Rapid Environmental Assessment (REA)**
- **Through the Sensor Data Collection**



# The 4-D "Cube"

## Feature Foundation Data (Static Characterization)

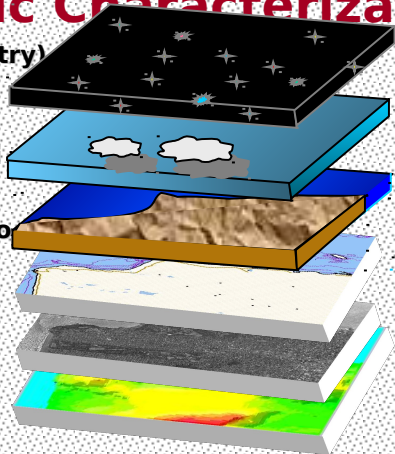
Space (Astrometry)  
& Time

Atmosphere  
Characterization

on Ocean  
Characterization

Nav Data  
Imagery

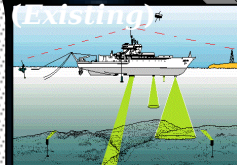
Terrain



Navy

NIM

Military  
Survey  
Ships  
(Existing)



Data  
Management

METOC Center



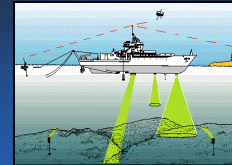
Common  
Operational  
Picture

Mission  
Planning  
Systems

Weapon  
Systems



Multi-Mission  
Support Ship  
(Future)

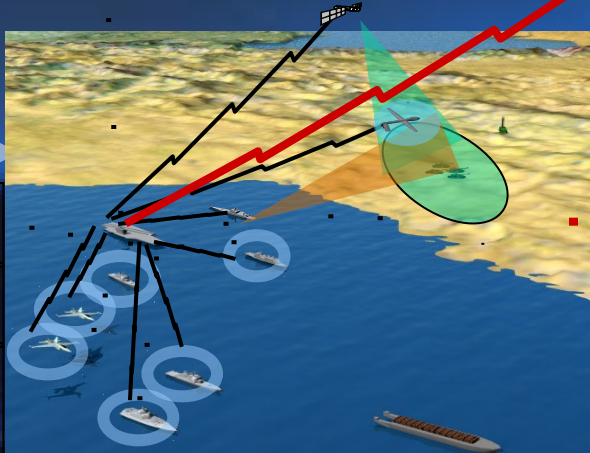


## Rapid Environmental Assessment

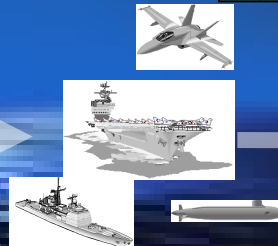
Thru The  
Sensor Data

Dedicated  
sensors

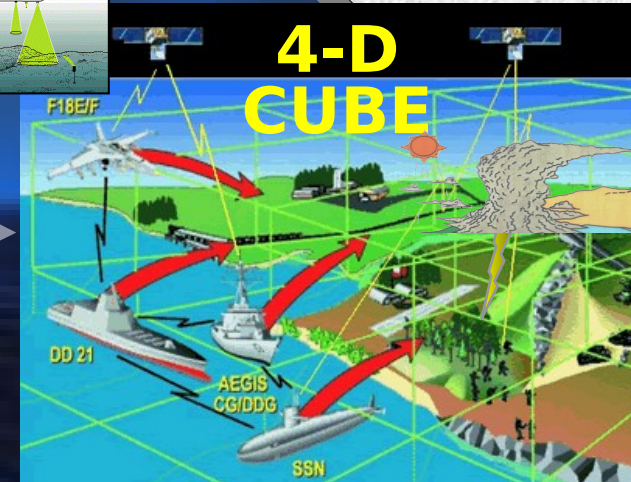
On scene  
processing &  
delivery



Force and  
Threat Data



4-D  
CUBE



## Dynamic Nowcast/Forecast



# Our Goal

As stated in the Navy's M&S Master Plan:

***“Ensure that authoritative representations of the ocean environment are defined and accessible to the DoD M&S analysis, acquisition, and training communities.”***



# MSEA Role

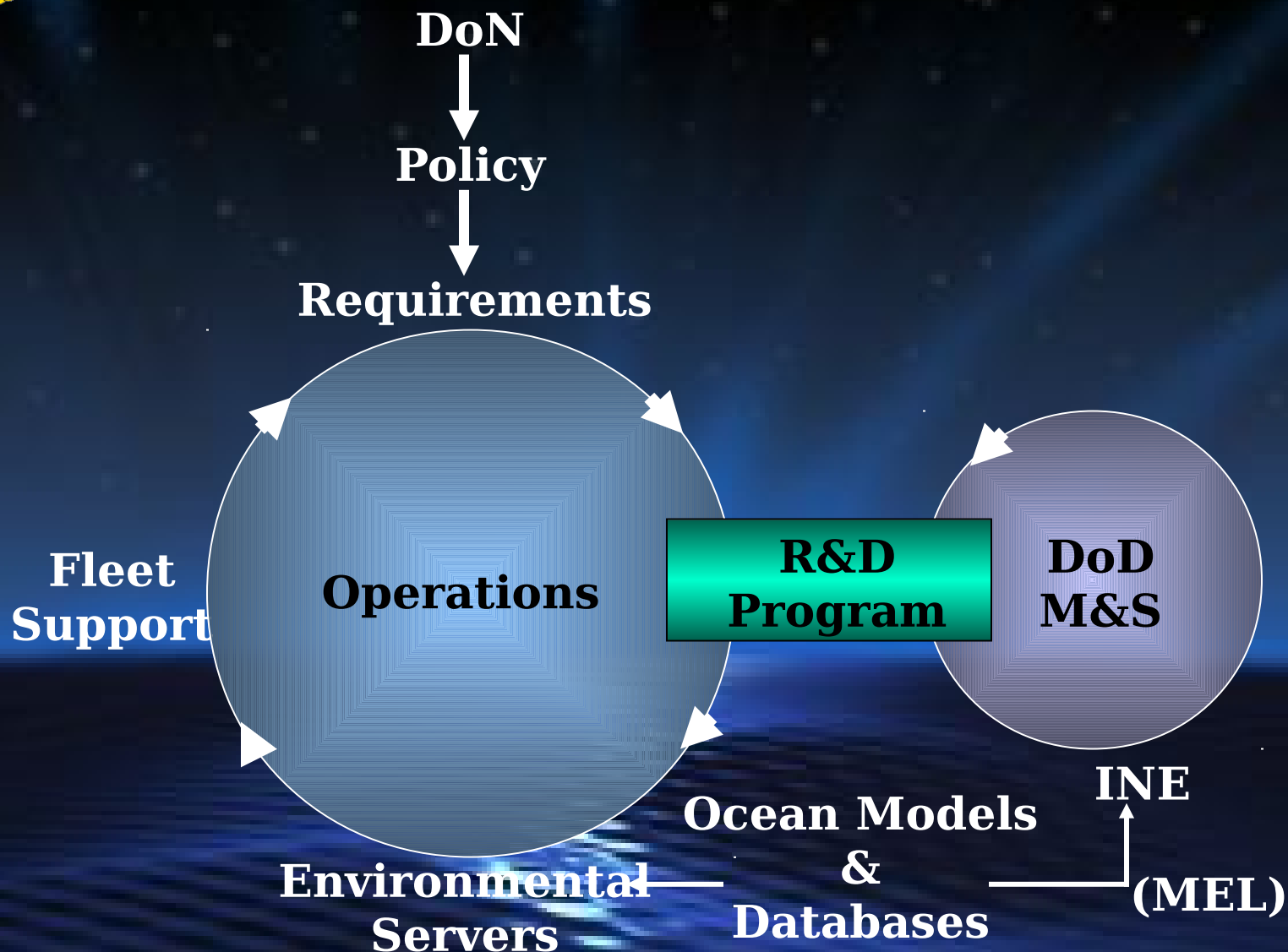
- Facilitator in the project startup phase
- Catalyst during development
- Certifier in the capability delivery/migration phase of a simulation.

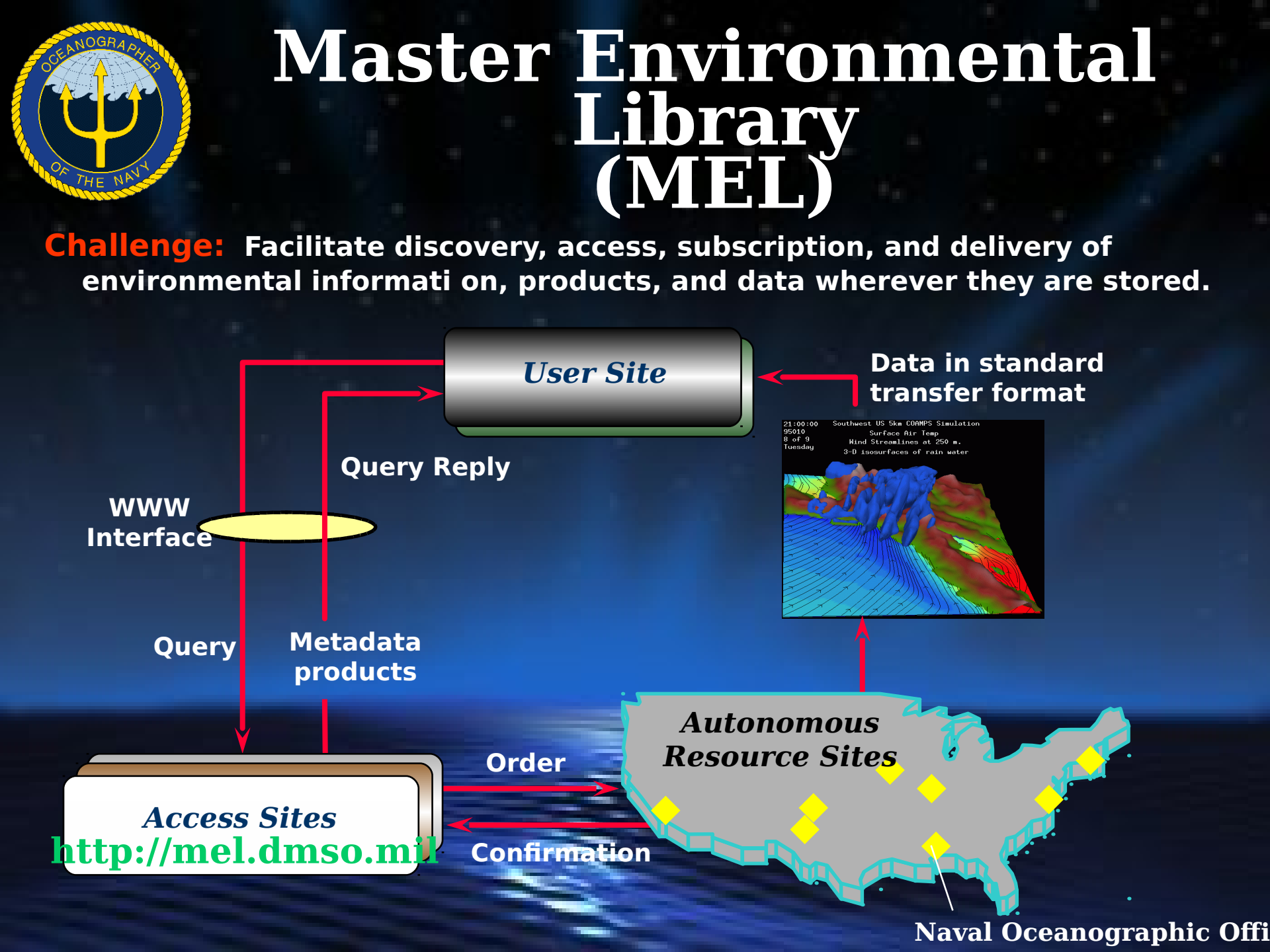






# Operational Concept







# Ocean and Atmospheric Master Library

- **Navy Standard** library of models, algorithms and databases for use in operational METOC prediction systems.
- 59 configure-managed items are available:
  - 19 Data Bases
  - 33 Models
  - 7 Algorithms
- 34 more approved for development
- Independent model and database V&V panels



# OAML Library Items

Representational Example as of Oct 2000

## OCEAN MODELS

MODAS 1.0  
Naval Search and Rescue 1.0  
Surf Prediction 3.0  
Shallow Water REF/DIF 1.0

## OCEAN DATA BASES

GDEM PROV. 4.0  
ICECAP 2.0  
Historical Temporal Shipping-V  
1.1  
GDEM-V 2.5  
GDEM-Province 4.0

## SENSOR SPECIFIC DATA BASES

VLAD NOISE GAIN 2.0

GI&S PRODUCTS (Digital  
Bathy)  
DBDB-V Ver 3.0

## ACOUSTIC MODELS

Parabolic Equation 5.0  
ASTRAL 5.0  
ASPM 4.3  
Gaussian Ray Bundle 1.0  
High Freq Env Acoustic  
(HFEVA) 1.0  
COLOSSUS II 1.0  
Low Freq Bottom LOSS 2.4  
(LFBLTAB)  
Surface LOSS 2.0  
System LOSS 1.0  
Active LOSS 2.0  
CASTAR 1.0  
CASS 3.0

## ACOUSTIC DATA BASES

High Freq BL 2.1  
Low Freq BL 9.1  
Consolidated BLUG 1.1

Vol Scattering Strength 6.2

Wind & Rainfall Noise 2.1



# OAML Library Items

Representational Package, October 2000

## **ATMOSPHERIC MODELS**

MUF 1.1  
LUF 1.1  
EDH 1.0  
RFSDR 1.0  
CLUTTER 1.1  
STD EM PROP. 1.0  
SSR 1.0  
RADFO 1.0  
FLIR 2.0  
CHAFF TRAJ. 1.0  
CHAFF DISP. 1.0  
METBAL 1.0  
RPO 1.16  
RIA 1.0  
MVOI 1.0  
VLSTRACK 2.0

## **ATMOSPHERIC DATABASES**

HEPC 1.0  
UAGC 1.1  
GTCT 1.0  
NHECT 1.0  
SMGC 1.0

## **ALGORITHMS**

SLAC 3.0  
Wilson Sound Speed 1.0  
TEMP/UTIL 1.0  
D-Values 1.0  
PADA 1.0  
Surface Scattering Strength  
1.0





# M&S Issues

- Rapid Data Assimilation in M&S
- Surf models for shallow water special operations
- A nesting of ocean-related models and products
- Timely demonstrations to assess progress/effectiveness



# Rapid Data Assimilation in M&S

(Same as for Operations)



Remote Sensors

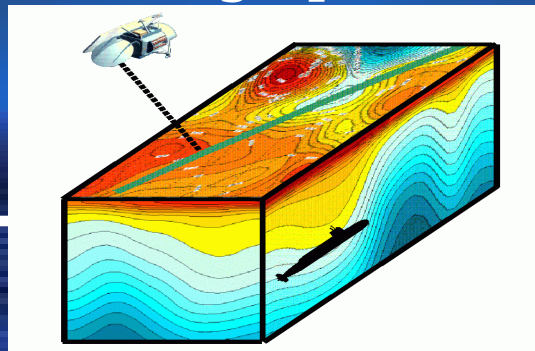
- MCSST & Altimetry
- Air, Buoy, & Ship XBTs
- Through-the-Sensor

NAVOCEANO



Global Data Fusion

Compressed  
Oceanographic Data



Local XBT Measurements

METOC Centers

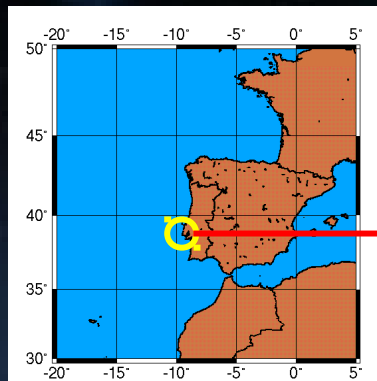


Regional Fusion  
& Tailored  
Operational Support

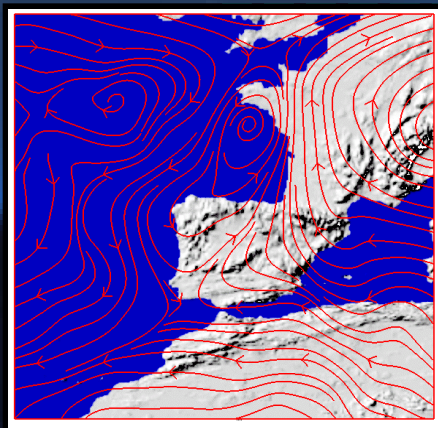


# Integrated Wave to Surf Modeling

## WAVE MODELS

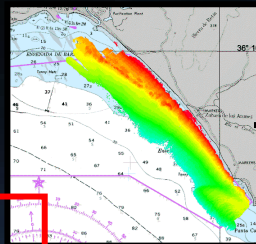


Wind Stress



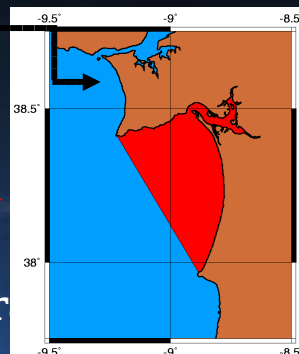
COAMPS

## Bathymetry



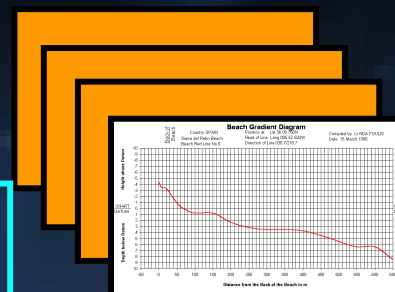
Deep-water  
Wave Spectra

## WAVE REFRACTION MODEL (REF/DIF1)

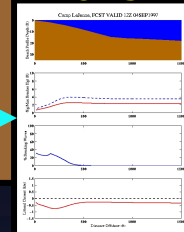


Refracted  
Wave Spectra

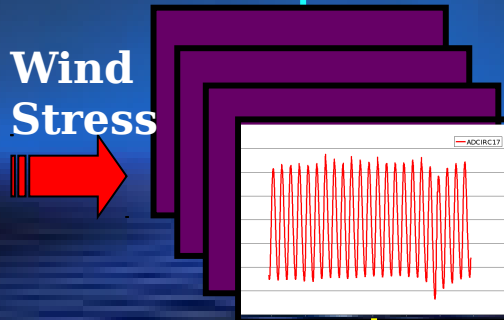
## Beach Profile Data



BEACH 1  
BEACH 2  
BEACH 3



Wind  
Stress



WIND-DRIVEN  
TIDES

ADCIRC or PCTIDES  
(fixed) (relocatable)

SURF FORECASTS  
(TEXT, GIFS)



# Distributed Integrated Ocean Prediction System (DIOPS 1.0)

## Beach Profiles

- Navy SEAL Team Survey
- Constant slope
- Sediment-based
- REA (SHOALS etc.)
- Blended

## Shallow-Water Directional Wave Spectra

- STWAVE
- REFDIF

## Tides

- ADCIRC
- PC-TIDES
- Tide Tables

## Winds

- COAMPS
- Other

**SURF3.0**

## **SURF 3.0 OUTPUT:**

- Significant wave height
- Significant breaker height
- Peak period, Breaker period
- Breaker Type:
  - Spilling
  - Plunging
  - Surging
- Breaker Angle
- Surf Zone Width
- Longshore Current
- Modified Surf Index





# Nesting of Ocean-related Models and Teleproducts Strategy

## Global/Mesoscale/Tactical/Nowcast Scales

### NOGAPS:

- FNMOC spectral model, T239/L36\*
- Data assimilation; 0-10 day guidance
- Provides boundary conditions for COAMPS coarse mesh

\* Scheduled for FY02

### COAMPS:

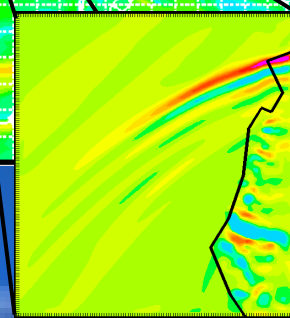
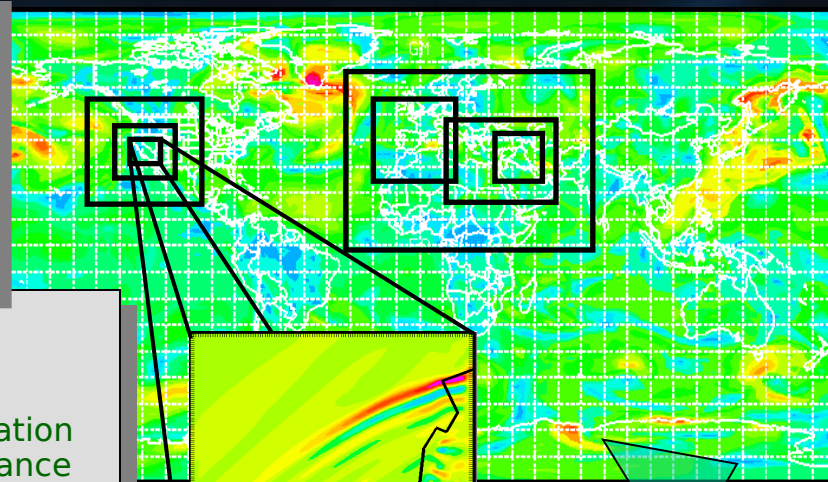
- FNMOC nonhydrostatic model, <9 km/L30
- Globally relocatable; Data assimilation
- Explicit moist physics; 0-72h guidance
- Provides boundary conditions for on-scene COAMPS coarse mesh

### TAMS/RT (6.4) / (DAMPS):

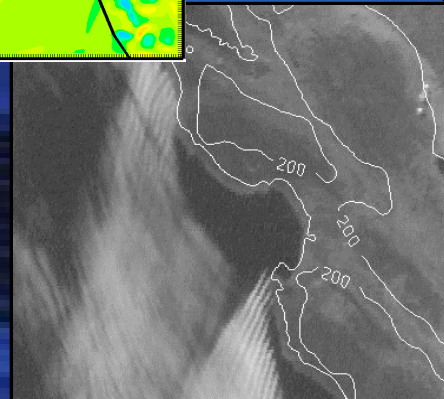
- On-scene tactical data assimilation
- COAMPS, METOC database, GUI
- Tactical weather; 0-48h guidance

### NOWCAST (6.2):

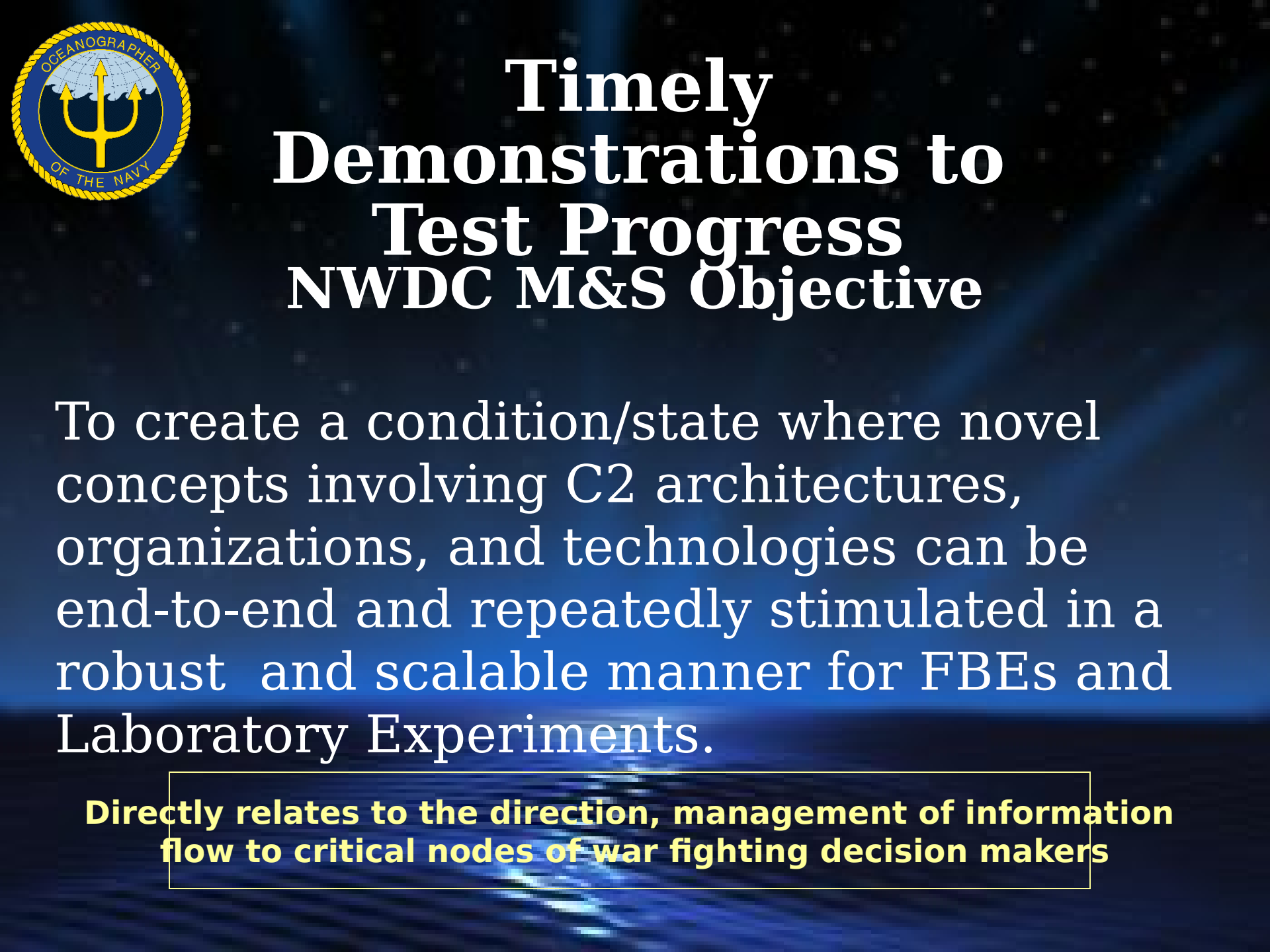
- Battlegroup mesonet concept
- Fuse observations and model output
- Common battlespace environment
- Tactical end users; 0-6h guidance



Observations







# Timely Demonstrations to Test Progress NWDC M&S Objective

To create a condition/state where novel concepts involving C2 architectures, organizations, and technologies can be end-to-end and repeatedly stimulated in a robust and scalable manner for FBEs and Laboratory Experiments.

**Directly relates to the direction, management of information flow to critical nodes of war fighting decision makers**



# FBE Concept of Operations

- Set Conditions
- Establish Access
- Conduct Initial Strikes & Joint Tactical Actions
- Sustain
- Achieve Dimensional / Time-definite Superiority

Monterey

Land Ranges

Nellis

Las Vegas

China Lake

Ft Irwin

Vandenberg

Edwards

Point Mugu

29 Palms

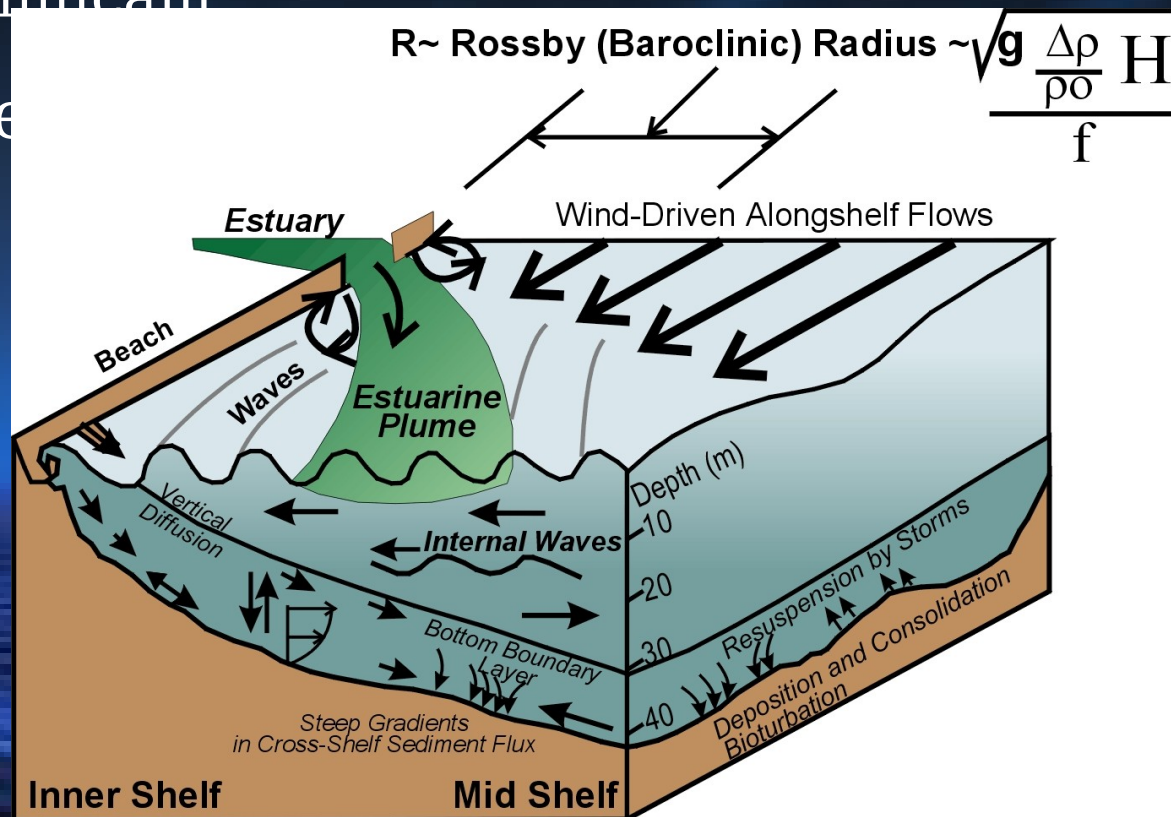
Los Angeles

San Nicholas



# Assessing Model Effectiveness

- A Problem of Time: Refresh rates.
  - Littoral Ocean Regions are characterized by long and short term factors, but unlike the deep water, short term effects are more significant
- A Problem of Space
  - Rapid changes in bottom slopes create the need for non-uniform grids



Ref: Nittrouer and Wright (1994).



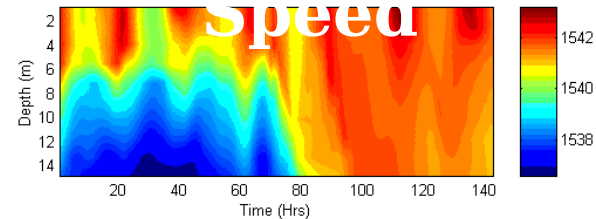
# Ocean Sensitivity Study

## Gulf of Mexico

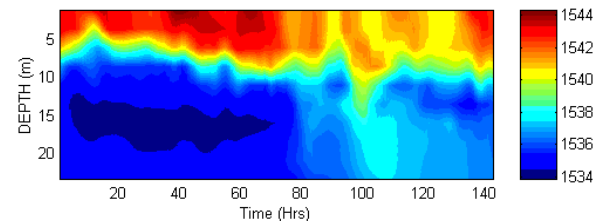
Aug 29 to Sept 3, 1999

### Sound

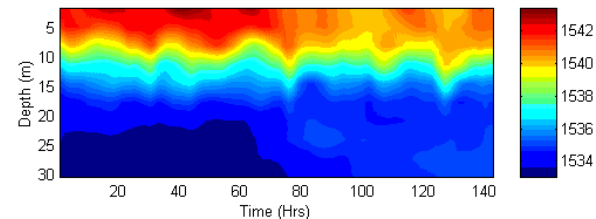
Speed



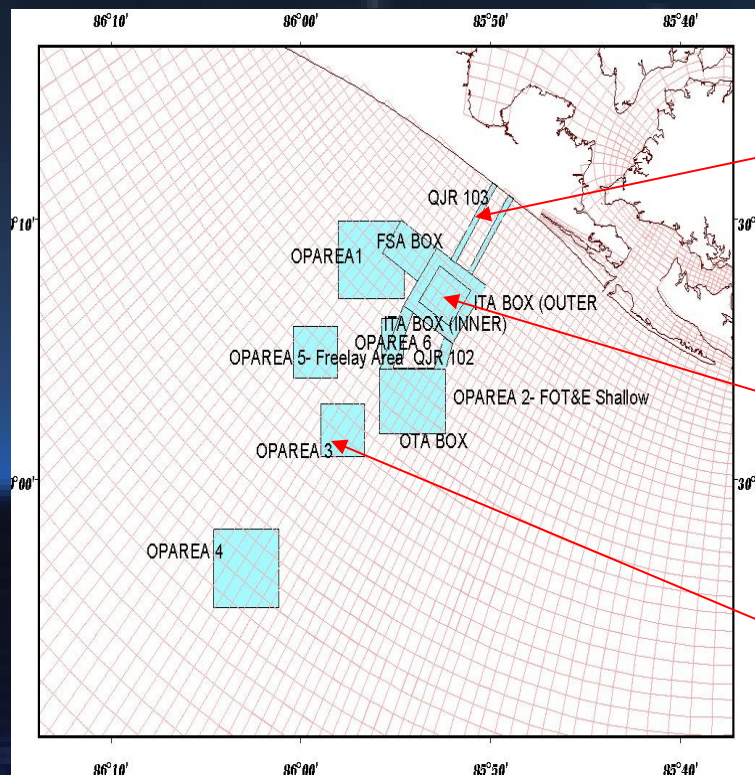
QJR 103



ITA Box Inner



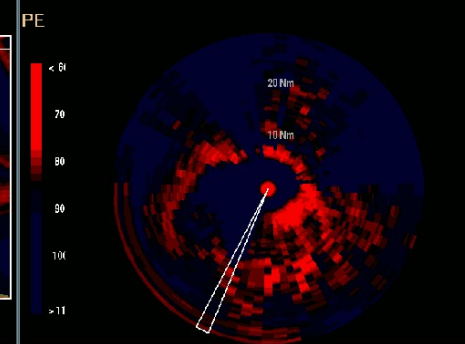
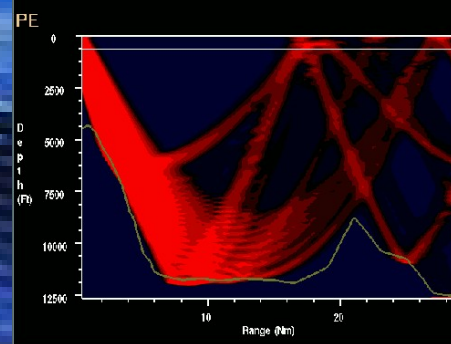
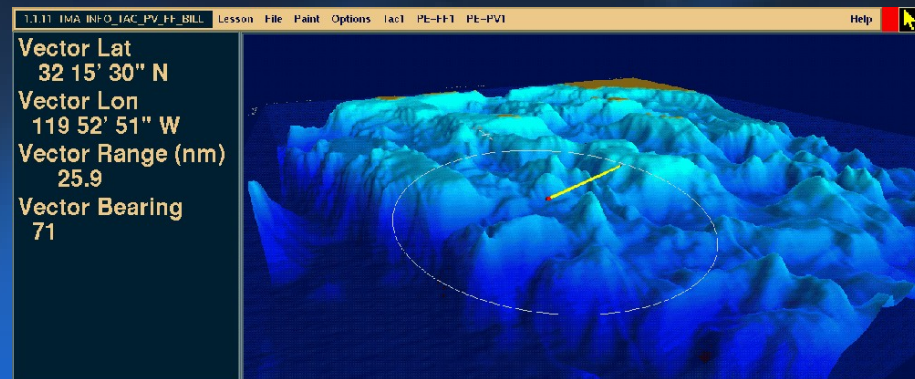
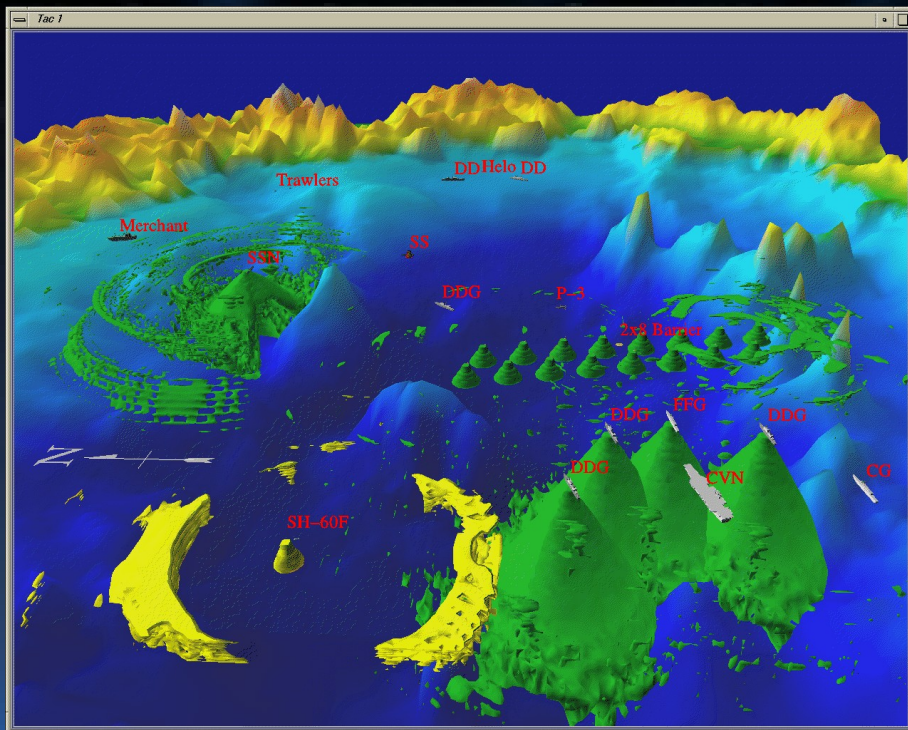
OPAREA 3







# Effectiveness of M&S

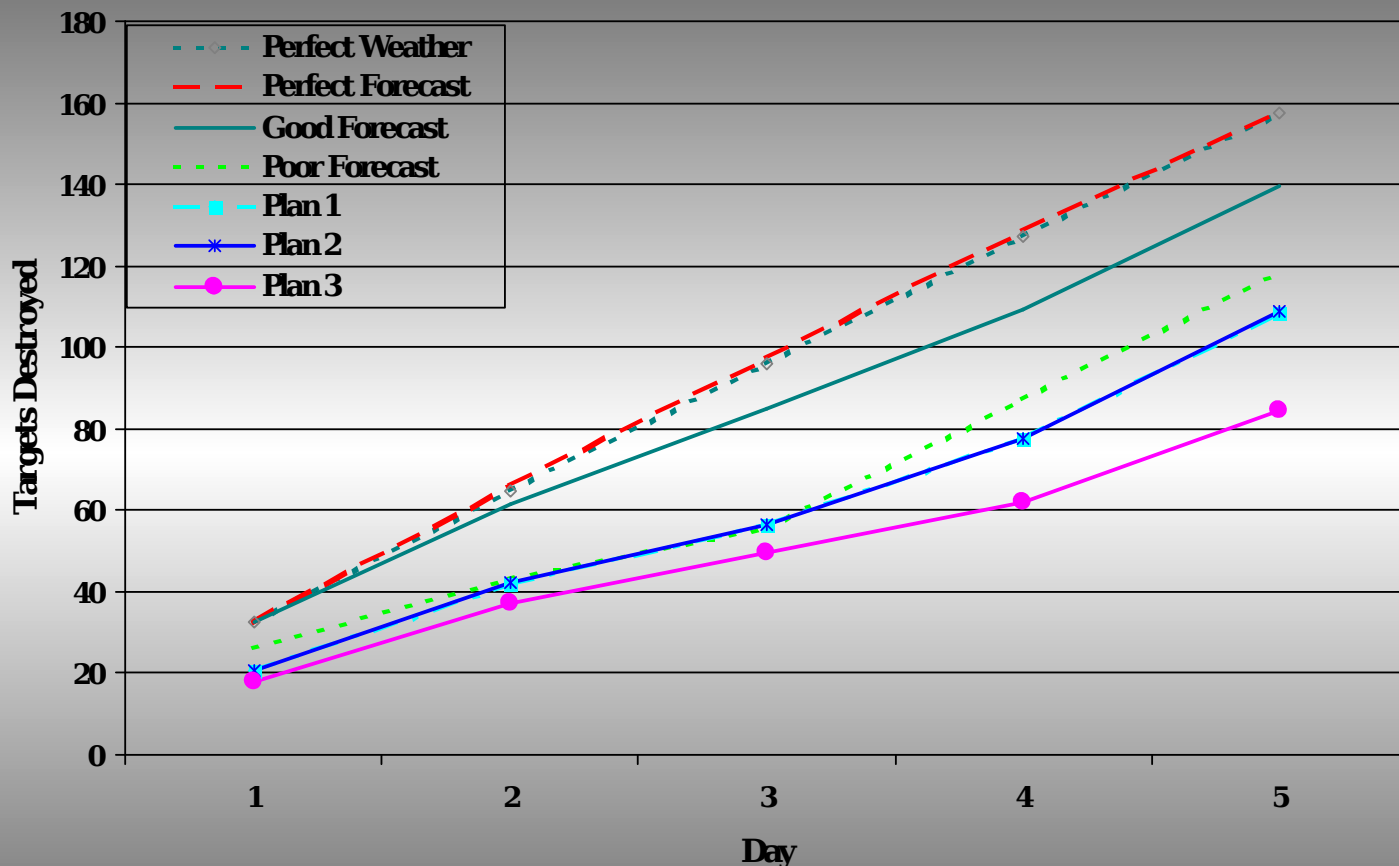






# Environmental Impact

## Targets Destroyed



- Developed weather pattern - clouds, ceiling, visibility, precip, temp.
- Modeled weather, impact on flights & available



# The Way Ahead in Ocean M&S

- **Display technologies**
- **Sensitivity to the environment**
  - Sensitivity studies
  - Impact studies and products
- **Data acquisition**
- **Resolution**
  - Space and time



# Industry's Role

- **Rapid Environmental Assessment**
- **Sensor Development / Integration**
- **Through the Sensor Technologies**
- **Information Fusion**



# Contact Information

## Policy

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## Technical

**Ed Weitzner**

**202-762-0264**

**weitzner.edward@hq.navy.mil**



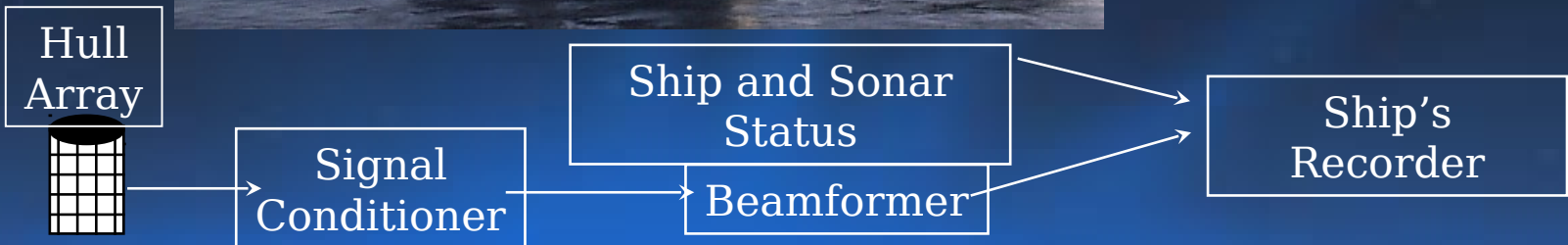
# Back Up Slides



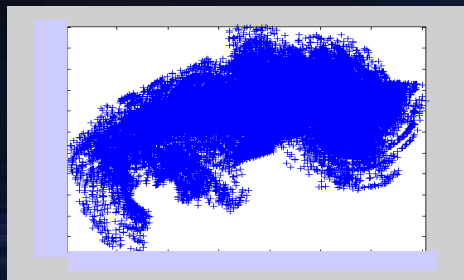


# Through the Sensor Data Collection

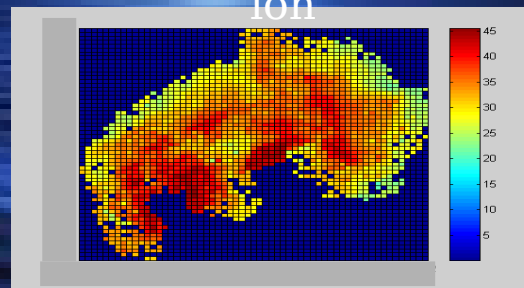
SABLE currently processes recorded active sonar returns from the AN/SC



Database Filtering



Reverberation



Scattering Strength

